A Retrospective Study of Tibial Plateau Leveling Osteotomy Cases in Canines with Cranial Cruciate Ligament Rupture

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Abstract

Each day, the small animal orthopedic surgeons at The Ohio State University's Veterinary Medical Center see a handful of patients with hindlimb lameness. Although lameness could indicate a number of orthopedic or neurological issues, rupture of the cranial cruciate ligament (CCL) of the stifle is frequently the cause. Owners often elect surgery to repair the torn ligament, with tibial plateau leveling osteotomy (TPLO) as the favored procedure. This study reviewed retrospective data from TPLOs performed in 2012 to identify potential factors associated with CCL rupture. Age, body condition, and previous orthopedic conditions were expected to be of greatest interest in this study. A total of 201 TPLOs performed on 189 dogs throughout 2012 were reviewed. There was a significant difference ($p = 0.001$) in the age at surgery of small and large breed dogs receiving a TPLO; the median age in small breed dogs was 8.0 years old compared to 5.1 years in large breed dogs. A total of 32% of dogs were considered overweight at the time of surgery. Only 18% of large breed dogs had been previously diagnosed with orthopedic conditions, but 44% of small breed dogs had other orthopedic problems prior to CCL rupture. Also of note was the occurrence of meniscal injury in approximately half of the cases. Additionally, at the conclusion of data collection, 42% of dogs experienced contralateral CCL rupture prior to or during the study period.

Introduction

The most common orthopedic injury and cause of hindlimb lameness in canines is rupture of the cranial cruciate ligament (CCL).[1] It is estimated that $1.32 billion was spent to treat CCL ruptures in the United States in 2003.[2] CCL rupture may occur over time following progressive development of degenerative joint disease in the stifle, or less frequently, upon acute injury and trauma.[3,4] Instability of the stifle joint resulting from a ruptured CCL results in the progression of osteoarthritis, and may lead to secondary injury of the menisci. Although CCL rupture can be treated through medical management, owners often elect surgical options to stabilize the joint and decrease lameness and pain; there are a number of surgical methods available for ruptured CCL repair.[5] While nonsurgical medical management may be suitable in many CCL cases in small breed dogs, surgery is often highly recommended in larger dogs.[6] A tibial plateau leveling osteotomy (TPLO) procedure is commonly performed to repair CCL ruptures by altering the angle of the tibial plateau, which removes the tibial thrust force acting on the stifle and stabilizes the joint.[5] Rupture in the contralateral stifle joint often occurs, frequently within a year of the initial injury.[7]

The objective of this study was to review the demographics of patients receiving a TPLO and to identify potential factors significant to the incidence of cranial cruciate ligament rupture in canines. It was hypothesized that factors of age, deviance from ideal weight, and history of outstanding orthopedic conditions may hold importance in the occurrence of CCL rupture.

Materials and Methods

A retrospective review was completed of 189 canine CCL rupture case files of client-owned dogs receiving a TPLO procedure at The Ohio State University Veterinary Medical Center in 2012. Diagnosis of cruciate rupture was determined through thorough orthopedic examination with radiographic changes consistent with CCL rupture. Final diagnosis of the extent of the rupture and status of the menisci was determined during surgery. The following information was recorded from each file:

- Gender
- Age at surgery
- Weight at surgery
- Body Condition Score on 5 point scale
- Date of surgery
- Limb affected
- Period of lameness (acute, chronic)
- Extent of injury (complete, partial)
- Status of meniscus (intact, torn)
- Post-surgical complications
- Outstanding orthopedic history

Results

Of the 189 TPLO patients, 54% (102) were male (7 intact) and 46% (87) were female (5 intact). A total of 201 TPLOs were performed on these 189 dogs in 2012, 105 on left and 96 on right stifles. Bilateral rupture was diagnosed in 79 cases before or during the data period. Overall median age at surgery was 5.42 (range, 1 year – 14.7 years) and median weight was 36.3kg (range, 4.3kg – 98kg). Breeds were mixed (21%, 40 dogs) or various purebreds (79%, 149 dogs) with 33 different breeds represented. Most commonly affected of the purebreds were the Labrador Retriever (n = 40), Golden Retriever (13), German Shepherd Dog (10), Rottweiler and American Bulldog (7 each), and Doberman and Newfoundland (6 each). The onset of lameness was considered acute in 44% of cases, with lameness occurring at a specific point in time; onset was chronic in 55% of cases with lameness gradually worsening over a period of several months. Lameness history was unreported in the remaining 1% of cases. In 108 (54%) of cases, the CCL was found to be completely ruptured; partial ruptures were found in 61 (30%) of cases. The remaining 32 cases did not report the extent of the tear. Injury to either or both the medial and

lateral meniscus occurred in 85 (42%) of cases. At the time of surgery, 61 dogs (32%) were considered overweight. Dogs classified as overweight were those scoring a 4 or greater on a 5 point body condition score chart. Table 1 summarizes this data.

Table 1: Summary of Breed Independent Statistics

	Number	Percentage
Gender		
Male/Castrated	102	54%
Female/Spayed	87	46%
Limb Affected		
Left	105	52%
Right	96	48%
Bilateral	79	42%
Onset of Lameness		
Acute	88	44%
Chronic	110	55%
Extent of CCL tear		
Complete	108	54%
Partial	61	30%
Unreported	32	
Meniscal injury	85	42%
Overweight*	61	32%

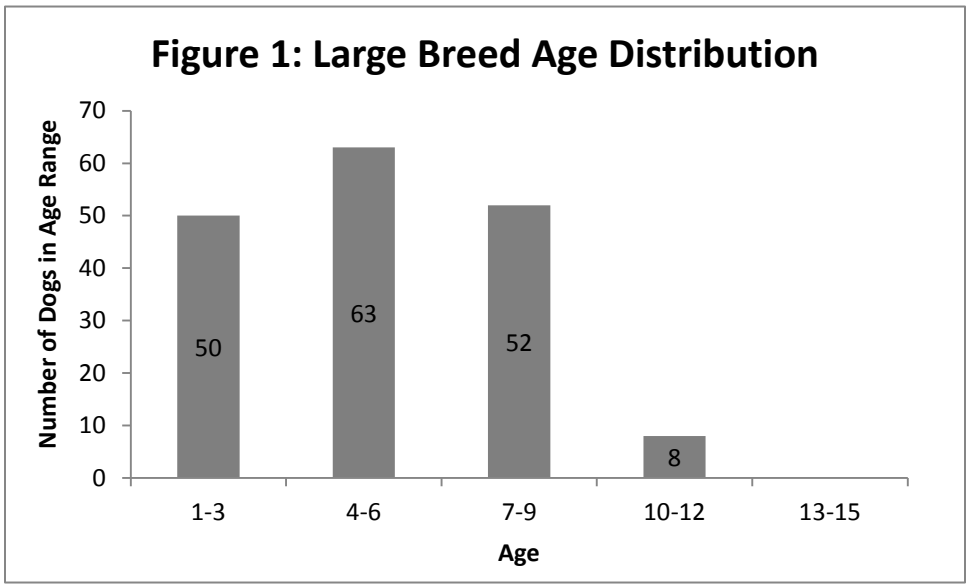
*Dogs scoring a 4 or greater on a 5 point BCS scale

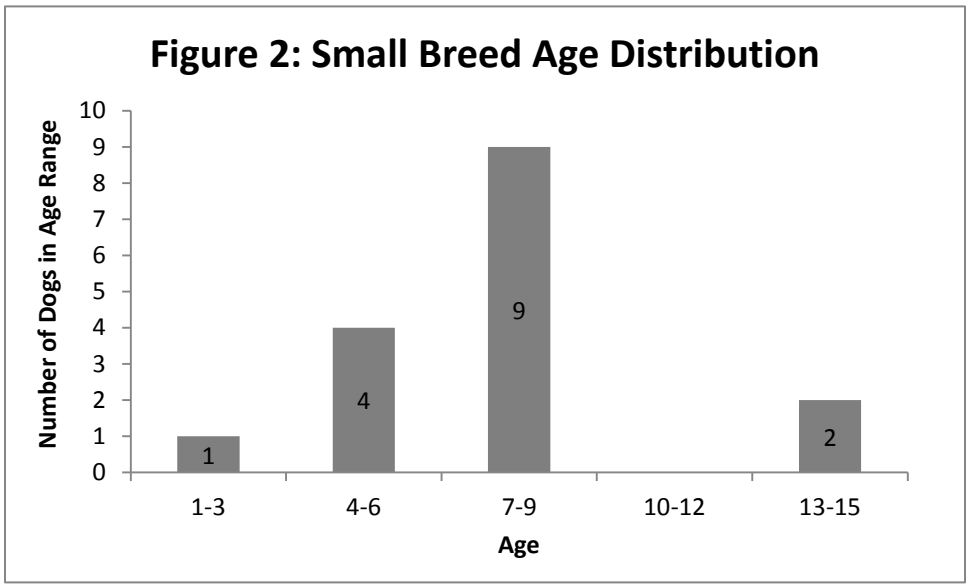
Cases were separated into small breed or large breed dog categories based on weight. A cutoff of 15kg was used to classify small breed dogs. All dogs over 15kg were placed into the large breed category. In the case of overweight dogs, categorization was determined by average breed weight. There was a significant difference ($p = 0.001$) in the age of the small breed dogs versus large breed dogs at the time of surgery. The median age for large breed dogs was 5.1 ± 2.6 years, while in small breed dogs it was 8.0 ± 3.1 years. The median weight of large breed dogs was 37.5 ± 13.1kg. Median weight was 11.1 ± 4.5kg in the small breed dogs. A total of 38 dogs had previously diagnosed orthopedic conditions. Of these, 7 (44%) of the small breed dogs and 31 (18%) of large breed dogs had a history of orthopedic issues, including patella luxation, hip or elbow dysplasia, and osteoarthritis of various joints. Table 2 summarizes the data comparison for large and small breed dogs.

Table 2: Comparison Between Large and Small Breed Dogs

	Large Breed Dogs	Small Breed Dogs*
Total TPLOs performed	184 (173 dogs, 11 with bilateral repairs)	17 (16 dogs, 1 with bilateral repair)
Median age at surgery	5.1 ± 2.6	8.0 ± 3.1
Median weight at surgery (kg)	37.5 ± 13.1	11.1 ± 4.5
Orthopedic history	31 (18%)	7 (44%)

*Dogs <15kg were placed in the small breed group; in case of overweight dog, categorized by average breed size





Discussion

This retrospective study reviewed the demographic population of dogs receiving tibial plateau leveling osteotomies for ruptured cranial cruciate ligament and analyzed data for potential factors associated with cruciate injury such as age, weight, and the orthopedic history of the dog. Because this study focused only on those dogs receiving the TPLO procedure, it is not necessarily representative of the total population of dogs with CCL ruptures. Most of the cases reviewed were large breed dogs; TPLO is often recommended for larger dogs over other treatment options, while other options may be suitable for smaller dogs. However, with the small number of small breed dogs that were included in the study, it was found that the median age of small dogs affected by CCL rupture was significantly greater than that of the large breed dogs. It has been proposed that cruciate injuries may have a greater genetic basis in large breed dogs which contributes to an earlier onset in these dogs. In contrast, small breeds may be subject to the gradual progression of degenerative joint disease and thus are affected by cruciate injuries later in life.[8]

At the time of surgery, one-third of dogs were considered over their ideal weight. While excess weight does not cause cranial cruciate rupture, the additional weight adds unnecessary stress to joints. This can slow the recovery rate following surgery and may contribute to a greater progression of osteoarthritis development in the joint.[9]

A previous history of orthopedic problems affected almost half of the small breed dogs. The most common orthopedic conditions including patella luxation, hip and elbow dysplasia, and osteoarthritis of various joints. The frequency of these conditions preceding cruciate injuries may relate to the increased age of the dog. Just as CCL rupture may result from the slow progression of degenerative joint disease in the stifle, these other orthopedic conditions may similarly occur simultaneously over time. Further research would be necessary in this area to determine whether the coincidence of cruciate injury and other orthopedic conditions occurs due to additional stress on the stifle joint from compensatory weight shifting off of limbs affected by other orthopedic problems.

The high incidence of contralateral cruciate rupture is of great interest. At the completion of this study, 42% of dogs experienced rupture of the contralateral cruciate ligament either before or during the research period. This percentage would be expected to increase if these dogs were followed outside of the study period.

Conclusion

Cranial cruciate ligament rupture is the major cause of orthopedic lameness in dogs. Through a greater understanding of the population of dogs affected by cranial cruciate ligament rupture, further research can be proposed to identify potential pathways in the pathophysiology of cruciate injuries and assist in future management or prevention.

References

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